IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of	)	
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MUROTANI et al.	)	**Art Unit 2655**
	)	
Application Number: 10/821,888	)	
	)	
Filed: April 12, 2004	)	
	)	
For: DISK ARRAY APPARATUS AND DISK ARRAY APPARATUS CONTROL METHOD	)	
	)	
	)	
ATTORNEY DOCKET NO. ASAM.0119	)	

Honorable Assistant Commissioner
for Patents
Washington, D.C. 20231

PETITION TO MAKE SPECIAL UNDER 37 C.F.R. § 1.102(d)

FOR ACCELERATED EXAMINATION

Sir:

Pursuant to 37 C.F.R. § 1.102(d), Applicants respectively request that the application be examined on the merits in conjunction with the pre-examination search results, the detailed discussion of the relevance of the results and amendments as filed concurrently.

Substantive consideration of the claims is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and telephone number indicated below.

Respectfully submitted,

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STATEMENTS & PRE-EXAMINATION SEARCH REPORT SUPPLEMENTAL TO THE PETITION TO MAKE SPECIAL

Sir:

Pursuant to 37 C.F.R. §§ 1.102 and MPEP 708.02 VIII, Applicants hereby submit that (1) all claims of record are directed to a single invention, or if the Office determines that all the claims presented are not obviously directed to a single invention, will make an election without traverse as a prerequisite to the grant of special status; (2) a pre-examination search has been conducted according to the following field of search; (3) copies of each reference deemed most closely related to the subject matter encompassed by the claims are enclosed; and (4) a detailed discussion of the references pointing out how the claimed subject matter is patentable over the references is also enclosed herewith.

FIELD OF THE SEARCH

The field of search includes the following classes:

Class	Subclasses	Description
707/		**DATA PROCESSING: DATABASE AND FILE MANAGEMENT OR DATA STRUCTURES**
	201	. Coherency (e.g., same view to multiple users)
	204	.. Archiving or backup

710/ DATA INPUT/OUTPUT		**ELECTRICAL COMPUTERS AND DIGITAL PROCESSING SYSTEMS:**
	20	. Concurrent Input/Output processing and data transfer
711/		**ELECTRICAL COMPUTERS AND DIGITAL PROCESSING SYSTEMS: MEMORY**
	154	. Control technique
	161	.. Archiving
	162	... Backup
	202	. Address mapping (e.g., conversion, translation)
	203	.. Virtual addressing
	206	... Translation tables (e.g., segment and page table or map)

The above subclasses represent areas deemed to contain subject matter of interest to one or more of the search features. The integrity of the search is based on the records as presented to us by the United States Patent and Trademark Office (USPTO). Also a key word search was performed on the USPTO full-text database including published U.S. patent applications.

The search was directed towards claims 1-18 of U.S. Application 10/821,888. The claims are generally characterized by a disk control apparatus connected to an information processing apparatus so as to be able to communicate with the information processing apparatus, the disk control apparatus writing/reading data into/from a first storage device having one or more logical volumes formed thereon, a second storage device having one or more logical volumes formed thereon, and a third storage device, the disk control apparatus comprising: a memory, association of identifiers of the logical volumes in said first storage device serving as identifiers of primary logical volumes with identifiers of the logical volumes in said second storage device serving as identifiers of secondary logical volumes being stored in said memory as a pair management table; a timing mechanism; a write request reception unit for receiving a write request of data for a logical volume in said first storage device and the data to be written, from the information processing apparatus; a first write unit responsive to reception of the write request, for writing the data into the logical volume in said first storage device; a journal write unit for writing journal data into said third storage device, the journal data comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing

mechanism, and the data; and a second write unit for referring to the update time of the journal data stored in said third storage device, selecting journal data for which a difference between current time acquired from said timing mechanism and the update time is longer that a predetermined time, referring to an identifier of the logical volume in the journal data, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage (See Conclusion paragraph for detailed references to drawings and specification).

LIST OF RELEVANT REFERENCES

The search revealed the following U.S. patents, which are listed for convenience:

U.S. Patent No.	Inventor
6,526,419 B1	Burton et al.
6,611,901 B1	Micka et al.
6,826,666 B2	Berkowitz et al.

U.S. Patent Application Publication No.	Inventor
2004/0260735 A1	Martinez et al.
2005/0004979 A1	Berkowitz et al.

Discussion of References:

US. Pat. No. 6,526,419 B1 to **Burton** et al. was assigned to International Business Machines Corporation and entitled "Method, System, and Program for Remote Copy in an Open Systems Environment". **Burton**'s hosts log-updates in a journal until they receive status that the update was successfully applied. In the event of a failure in a primary DASD 10a, a remote copy host reads a secondary state LUN 12b to determine the status of secondary LUNs shadowing data (col. 7, lines 6-9, and 13-19). However, **Burton** deploys a shadow pair (Abstract), i.e., TWO sets of replica, rather than just ONE replica and a third storage device for storing journal data. As such, **Burton** does not provide a third storage device for storing

journal data of the disk array as recited in claims 1, 11 and 18. As **Burton** does not involve any third storage device, a timing mechanism, a journal write unit for writing journal data into said third storage device while the journal data comprising "update time which is current time acquired from timing mechanism, and the data to be written", **Burton** does not provide "a journal write unit for writing journal data into said third storage device the *journal data* comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing mechanism, and the updated data" or "a second write unit for referring to the update time of the journal data stored in said third storage device, selecting journal data for which a difference between current time acquired from said timing mechanism and the update time is longer than a predetermined time, referring to an identifier of the logical volume in the journal data, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage device" as recited in claims 1, 11 and 18.

US. Pat. No. 6,611,901 B1 to **Micka** et al. was assigned to International Business Machines Corporation and entitled "Method, System, and Program for Maintaining Electronic Data as of a Point-In-Time". **Micka** copies data from source tracks to target tracks, where source and target locations may be on different logical volumes. In response to the initiation of the copy operation, a storage controller 8 generates source and target bit map data structures having bit map values that correspond to tracks at respective source and target physical locations (col. 5, lines 36-39). The storage controller 8 creates source and target bit maps having bit map values corresponding to each track, and a one on one value indicating that the point-in-time copy has been copied from a source track location to a target (col. 5, lines 25-27). The storage controller 8 further generates a relationship table 20 for each bit map that provides a mapping of the locations in the bit map to the source and target locations in DASD 6 of the data subject to the point-in-time copy (col. 5, lines 44-47; Fig. 2). However, **Micka's** relationship table 20 is stored in a memory of the storage controller 8 (Fig. 1), rather than a third storage device for storing journal data of the disk array 6. As such, **Micka** does not provide a third storage device for storing journal data of the disk array as recited in claims

1, 11 and 18. There is not any "update time which is current time acquired from timing mechanism, and the data to be written" in **Micka's** relationship table 20 or the storage controller 8 such that **Micka** does not record any journal data entry of the invention. As **Micka** does not involve a third storage device, a timing mechanism, a journal write unit for writing journal data into said third storage device while the journal data comprising "update time which is current time acquired from timing mechanism, and the data to be written", **Micka** does not provide "a journal write unit for writing journal data into said third storage device the *journal data* comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing mechanism, and the updated data" or "a second write unit for referring to the update time of the journal data stored in said third storage device, selecting journal data for which a difference between current time acquired from said timing mechanism and the update time is longer than a predetermined time, referring to an identifier of the logical volume in the journal data, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage device" as recited in claims 1, 11 and 18.

US. Pat. No. 6,826,666 B2 to **Berkowitz** et al. was assigned to Microsoft Corporation and entitled "Method and system for Transporting Data Content on a Storage Area Network". **Berkowitz**'s point-in-time copy interface module 304 (Fig. 3) combines received information with mapping and other application data prior to transporting information to a second computer. The module 304 combines LUN information, along with any mapping information to create a volume, such as a volume 318, which represents a copy of a requested volume 303(col. 9, lines 6-15). A LUN is a Logical Unit Number and relates to a virtual device that is "surfaced" by the storage subsystem (col. 2, lines 13-15). The volume 318 is then "surfaced" on an importer module 320 (col. 9, lines 16-17). US. Pat. App. Pub. No. 2005/0004979 of **Berkowitz** provides similar disclosures. However, **Berkowitz's** point-in-time copy interface module 304 is external to a storage subsystem 308 of a provider 306 (col. 8, lines 24-29), rather than being an internal third storage device for storing journal data of a disk array. As such, **Berkowitz** does not provide a third storage device for storing journal data of the disk

array as recited in claims 1, 11 and 18. An import module 332 of the point-in-time interface module 304 packages information received from the providers relating to the location of a physical copy on storage subsystem 308. Using this information, the import module generates a self-contained description of the information to be surfaced on the importer 320, as well as any other information such as where the information resides, what other processes should be activated in order to access the information, etc. (col. 10, lines 3-11). There is not any "update time which is current time acquired from timing mechanism, and the data to be written" in **Berkowitz's** import module 332 or the interface module 304 such that **Berkowitz** does not record any journal data entry of the invention. As **Berkowitz** does not involve a third storage device, a timing mechanism, a journal write unit for writing journal data into said third storage device while the journal data comprising "update time which is current time acquired from timing mechanism, and the data to be written", **Berkowitz** does not provide "a journal write unit for writing journal data into said third storage device, the *journal data* comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing mechanism, and the updated data" or "a second write unit for referring to the update time of the journal data stored in said third storage device, selecting journal data for which a difference between current time acquired from said timing mechanism and the update time is longer than a predetermined time, referring to an identifier of the logical volume in the journal data, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage device" as recited in claims 1, 11 and 18.

US. Pat. App. Pub. No. 2004/0260735 A1 of **Martinez** et al. is entitled "Method, System, and Program for Assigning a Timestamp Associated with Data". When a host 4a, 4b...4n initiates a point-in-time copy operation for specified tracks in volumes 10a, 10b...10n in a source storage 8a to specified tracks in volumes 12a, 12b...12m in a target storage 8b, a storage management software 18 will generate a relationship table 20 information when establishing a logical point-in-time copy ([0025]; Fig. 1). A volume generation number 82 (Fig. 4) is a clock generating a timestamp that indicates the most recently created relationship generation number for the volume. The storage management software 18 (Fig. 2) establishes

point-in-time copy relationships between tracks in a source storage 8a and tracks in a target storage 8b. A relationship table entry 40 is generated by the storage management software 18, and indicates extent of source tracks 42 and target tracks 44 subject to a logical copy relationship, and source and target relationship generation numbers, as well as a relationship bitmap 50 (Fig. 2) indicating whether the data from a source track has been copied to a corresponding target track ([0029]-[0030]). When a write request for a source track is received, the source track is updated and then a track generation number is set for the updated track ([0039]). However, **Martinez's** relationship table 20 with entries 40 is stored in a system memory 16 of a storage controller 2 (Fig. 1; [0023]), rather than a third storage device for storing journal data of the disk array. As such, **Martinez** does not provide a third storage device for storing journal data of a disk array as recited in claims 1, 11 and 18. In addition, each *relationship table entry* 40 includes an extent of source tracks 42 indicating those source tracks in the source storage 8a involved in the point-in-time relationship and the corresponding extent of target tracks 44 in the target storage 8b involved in the relationship, wherein an ith track in the extent of source tracks 44 corresponds to the ith track in the extent of target tracks 46 ([0023]), but not any "updated data" such that the relationship table entry 40 is different form the *journal data entry* of the invention. As **Martinez** does not involve a third storage device or a journal write unit for writing journal data into said third storage device, containing the "updated data", **Martinez** does not provide "a journal write unit for writing journal data into said third storage device, the journal data comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing mechanism, and the updated data" or "a second write unit for referring to the update time of the journal data stored in said third storage device, selecting journal data for which a difference between current time acquired from said timing mechanism and the update time is longer than a predetermined time, referring to an identifier of the logical volume in the journal data, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage device" as recited in claims 1, 11 and 18.

Conclusion

Based on the results of the comprehensive prior art search as discussed above, Applicants contend that the disk control apparatus as now recited in independent claims 1, 11 and 18, especially the feature of "a journal write unit for writing journal data into said third storage device, the journal data comprising an identifier of the logical volume in said first storage device into which the data has been written, information of a location in which the data is stored in the logical volume, update time which is current time acquired from said timing mechanism, and the data" is patentably distinct from the cited prior art references.

In particular, as now recited in the claim 1 (for example, the embodiment shown in Figs. 12-13; pp. 30-32), the disk control apparatus 10 of the invention connected to an information processing apparatus 20 so as to communicate with the information processing apparatus 20. The disk control apparatus 10 writes/reads data into/from a first storage device 1201 (for storing original data) having one or more logical volumes formed thereon, a second storage device 1202 (for storing replica) having one or more logical volumes formed thereon, and a third storage device 1203 (for storing journal data; "*If a hardware fault has occurred in a hard disk drive 120 included in the first storage device 1201, the data in the logical volume 121 in the first storage device 1201 can be restored by using the logical volume 121 in the second storage device 1202 and the journal data 1701 stored in the third storage*" p. 50, lines 4-9; "the invention reduces the conventional 3rd storage capacity from 100% to 25 % if the update quantity per day is less than 20%" p. 47, lines 7-25). The disk control apparatus 10 comprises: a memory 133 in Fig. 1 or 1003 in Fig. 12, association of identifiers of the logical volumes 121 in said first storage device 1201 serving as identifiers of primary logical volumes with identifiers of the logical volumes 121 in said second storage device 1202 serving as identifiers of secondary logical volumes being stored in said memory as a pair management table 1501 in Fig. 13; a timing mechanism 1204; a write request reception unit 1301 for receiving a write request of data for a logical volume 121 in said first storage device 1201 and the data to be written, from the information processing apparatus 20; a first write unit 1302 (Fig. 20; p. 36, line 20 to p. 40, line 6) responsive to reception of the write request, for writing the data into the logical volume 121 in said first storage device 1201; a journal write unit 1301 (p. 40, line 7 to p. 41, line 7) for writing journal data 1701 (Fig. 17) into said third storage device 1203, the journal data 1701 comprising an identifier of the logical volume 121 in said first storage device 1201 into which the data has been written, information of a location in which the data is stored in the logical volume 121, update time

which is current time acquired from said timing mechanism 1204, and the data; and a second write unit 1304 (Fig. 23; p. 43, line 5 to p. 44, line 18; "*When updating the logical volume 121 in the second storage device 1202 by using the journal data 1701 stored in the third storage device 1203, it is not necessary to read out data from the first storage device 1201.*" p. 49, lines 24-28) for referring to the update time of the journal data 1701 stored in said third storage device 1203, selecting journal data for which a difference between current time acquired from said timing mechanism 1204 and the update time is longer than a predetermined time 1205, referring to an identifier of the logical volume in the journal data 1701, the location information and the data in order of the update time in the selected journal data, acquiring an identifier of a secondary logical volume having the identifier of the logical volume as an identifier of the primary logical volume from the pair management table 1501, and writing the data into a place indicated by the location information, in the logical volume indicated by the identifier of the secondary logical volume, in said second storage device 1202.

The invention recited in claim 11 is directed to a control method for disk control apparatus 10 recited in claim 1.

The invention recited in claim 18 is directed to a disk control apparatus 10 comprising: a channel control unit 131 for receiving a data write request for the logical volume from the information processing apparatus 20; a disk control unit 132 for writing the data received by said channel control unit 131 into the logical volume; a switching control unit 135 for connecting said channel control unit 131, said disk control unit 132 and a shared memory 133 so as to conduct communication; and the journal write unit 1303; and the second write unit 1304 recited in claim 1.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable consideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

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